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(54) **FORMING CONTROL APPARATUS, AND METHOD AND PROGRAM THEREFOR**
FORMUNGSSTEUERVORRICHTUNG SOWIE VERFAHREN UND PROGRAMM DAFÜR
APPAREIL DE COMMANDE DE FORMATION ET PROCÉDÉ ET PROGRAMME ASSOCIÉS

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Description**BRIEF DESCRIPTION OF THE DRAWINGS****BACKGROUND OF THE INVENTION****Field of the Invention**

[0001] The present invention relates to a technique for forming a three-dimensional object.

Description of the Related Art

[0002] In recent years, forming apparatuses for forming three-dimensional objects, so-called three-dimensional (3D) printers have been becoming widely prevalent.

[0003] Japanese Patent Application Laid-Open No. 2012-96426 discusses a technique for reducing a forming time period and the like by causing a computer (a personal computer (PC)) that issues a forming instruction to a forming apparatus to issue a single forming instruction for forming a plurality of target objects while placing the objects close to each other. More specifically, based on a plurality of pieces of model data and parameters set for forming them, the layout when the objects are collectively formed is determined before the forming instruction therefor.

[0004] The PC is able to issue such a single forming instruction for putting the plurality of pieces of model data together in advance and forming objects as discussed in Japanese Patent Application Laid-Open No. 2012-96426, if the forming instruction has not yet issued.

[0005] However, if, after a user issues the forming instruction based on some model data, the user gets the urge to further form, for example, another object relating to the object being formed by the forming apparatus, the user has had to reissue the forming instruction after completion of the forming process of the object that is being formed.

[0006] US 2016/046074 discloses a forming control apparatus as claimed in the per-characterizing portion of claim 1 herein.

SUMMARY OF THE INVENTION

[0007] According to a first aspect of the present invention, there is provided a forming control apparatus as specified in claims 1 to 7. According to a second aspect of the present invention, there is provided a control method as specified in claims 8 to 12. According to a third aspect of the present invention, there is provided a program as specified in claim 13.

[0008] Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

[0009]

Fig. 1 illustrates an example of a configuration of a system according to an exemplary embodiment of the present invention. Each of the embodiments of the present invention described below can be implemented solely or as a combination of a plurality of the embodiments or features thereof where necessary or where the combination of elements or features from individual embodiments in a single embodiment is beneficial.

Figs. 2A and 2B illustrate examples of hardware configurations of apparatuses according to the present exemplary embodiment.

Figs. 3A-1, 3A-2, and 3B illustrate examples of forming methods to which the present exemplary embodiment is applicable.

Fig. 4 illustrates an example of a module configuration of software of the apparatuses according to the present exemplary embodiment.

Fig. 5 is a flowchart illustrating a procedure of a delayed join process.

Figs. 6A and 6B illustrate examples of a forming position in the delayed join process.

Figs. 7A, 7B, and 7C illustrate examples of screens displayed in the delayed join process.

Fig. 8 illustrates an example of a setting screen for making forming settings for the delayed join process.

Fig. 9 illustrates a flow of a forming process performed by the forming apparatus and a timing of an instruction for the delayed join process.

DESCRIPTION OF THE EMBODIMENTS

[0010] Exemplary embodiments of the present invention will be described below with reference to the drawings.

[0011] The exemplary embodiments of the present invention will use a term "delayed join process" to refer to a method for, in the middle of one forming process for some object at a forming apparatus, instructing the forming apparatus to additionally form another object and forming the plurality of objects collectively in the single forming process, and will propose methods for realizing the delayed join process.

[0012] For the "delayed join process" according to the present exemplary embodiments, there are a method that is forming the plurality of objects in parallel from half-way through the single forming process, and a method that is forming the plurality of objects sequentially during the single forming process.

[0013] Fig. 1 illustrates an example of a configuration of a system according to a first exemplary embodiment of the present invention.

[0014] A personal computer (PC) 103 and a forming apparatus 102 are connected to each other via a network

101, such as a local area network (LAN).

[0015] The PC 103 transmits forming data for forming a target object to the forming apparatus 102. The forming apparatus 102 receives the forming data and performs a forming process for forming a three-dimensional object. There may be a plurality of forming apparatuses in the system, and a user who uses a forming apparatus can arbitrarily select an apparatus with which the user wants to perform the forming process from the plurality of forming apparatuses.

[0016] Figs. 2A and 2B illustrate examples of hardware configurations of the apparatuses according to the present exemplary embodiment. Fig. 2A illustrates a configuration of an information processing apparatus, such as the PC 103. Fig. 2B illustrates a configuration of the forming apparatus 102.

[0017] In the information processing apparatus illustrated in Fig. 2A, a central processing unit (CPU) 201 performs a process based on each code of an application program, a program for forming control according to the present exemplary embodiment, or the like stored in a read only memory (ROM) 203 or an external memory 211, and comprehensively controls each of devices connected to a system bus 212. Further, the CPU 201 opens registered various kinds of application windows based on a command issued with, for example, a not-illustrated mouse cursor on a display 209, and performs various kinds of data processing.

[0018] A random access memory (RAM) 202 functions as a main memory, a work area, and the like of the CPU 201. The ROM 203 is a read only memory that functions as an area for storing a basic input/output (I/O) program and the like. The ROM 203 or the external memory 211 stores, for example, an operating system (hereinafter referred to as an OS), which is a control program of the CPU 201. Further, the ROM 203 or the external memory 211 stores a file and other various kinds of data to be used in the process based on the above-described application program or the like.

[0019] A network interface (I/F) 204 connects to the network 101 and carries out network communication. An input I/F 205 controls inputs from a keyboard 206 and a pointing device 207, such as a mouse. A display I/F 208 controls a display on the display 209. An external memory I/F 210 controls access to the external memory 211, such as a hard disk (HD).

[0020] The external memory 211 stores a boot program, various kinds of applications, the program for the forming control according to the present exemplary embodiment, a user file, an editing file, and/or the like. The computer 103 operates with the CPU 201 executing the basic I/O program and the OS written in the ROM 203 or the external memory 211. The basic I/O program is written in the ROM 203, and the OS is written in the ROM 203 or the external memory 211. Then, when the computer 103 is powered on, the OS is written from the ROM 203 or the external memory 211 into the RAM 202 by an initial program load function in the basic I/O program, and

then an operation of the OS is started.

[0021] In the forming apparatus 102 illustrated in Fig. 2B, a network I/F 251 connects to the network 101 and carries out network communication. Besides that, the forming apparatus 102 may also include a Universal Serial Bus (USB) interface. The forming apparatus 102 will receive a forming instruction and the forming data corresponding to the target object via the network I/F 251 or the not-illustrated USB I/F.

[0022] A CPU 252 comprehensively controls each of devices connected to a system bus 265 based on an application program, a program for the forming control according to the present exemplary embodiment, or the like. Especially, the CPU 252 outputs, for example, a control signal for the object formation to a forming unit 264 via a controller 263. A control program is stored in a ROM 254, an external memory 262, or the like. The CPU 252 is configured to be able to perform a communication process with the computer 103 via the network I/F 251, and notify the computer 103 of information in the forming apparatus 102 and the like. Further, the CPU 252 performs a process based on, for example, the application program stored in the ROM 254 or the external memory 262.

[0023] A RAM 253 functions as a main memory, a work area, and the like of the CPU 252, and is configured to be able to extend its own memory capacity by an optional RAM connected to a not-illustrated extension port. The RAM 253 is used as an area into which output information is developed, an area in which environmental data is stored, a nonvolatile random access memory (NVRAM), and/or the like. The ROM 254 or the external memory 262 stores the control program of the CPU 252, the application program, font data to be used when the above-described output information is generated, information to be used on the forming apparatus 102, and the like. Further, the ROM 254 or the external memory 262 temporarily stores an application when the application is installed into the forming apparatus 102.

[0024] An operation unit I/F 255 is in charge of an interface with an operation unit 256, and outputs image data that should be displayed to the operation unit 256. Further, the operation unit I/F 255 also receives information input by the user via the operation unit 256. The operation unit 256 corresponds to, for example, an operation panel on which a switch for an operation, a light emitting diode (LED) indicator, and the like are provided. A printer I/F 257 outputs an image signal as output information to a printer 258 (a printer engine). A sensor I/F 259 receives a signal as input information from a sensor 260 (a temperature sensor, a vibration sensor, an object identification sensor, or the like). Examples of the sensor 260 further include a sensor that detects a remaining amount of a consumable material to be used in the formation in a material feeding unit set on the forming apparatus 102.

[0025] The consumable material such as liquid and powder may be supplied according to a style of supplying it by detachably mounting a cartridge containing the con-

sumable material onto the material feeding unit. Alternatively, the consumable material may be supplied according to a style of manually replenishing the consumable material from a special bottle or the like into the material feeding unit.

[0026] An external memory I/F (a memory controller) 261 controls access to the external memory 262, such as an HD and an integrated circuit (IC) card. Further, the forming apparatus 102 may include not only a single memory but also at least one or more memory or memories as the above-described external memory 261, and be configured to allow connections of a plurality of external memories storing an optional font card usable in addition to a built-in font or a program that interprets a printer control language belonging to a different language series. Further, the forming apparatus 102 may include a not-illustrated NVRAM, and be configured to store information about a printer mode setting set from the operation unit 256.

[0027] The controller 263 causes the forming unit 264 to perform the forming process based on the received signal for the three-dimensional object formation. The forming unit 264 includes equipment for layering the material, a stage where the object is formed, a device functioning as an energy source for curing the material, and the like, although the included components vary depending on a forming method. The forming unit 264 is configured in a different manner according to the forming method, and specific examples thereof will be described below with reference to Figs. 3A-1, 3A-2, and 3B.

[0028] Although not being illustrated, examples of an optional device addable to the forming apparatus 102 include supplementary equipment that may be required according to the forming method, and a peripheral device that extends the functionality and mechanism of the three-dimensional (3D) printer, such as a camera and an IC card reader. Examples of the supplementary equipment include a device required as a measure against powder in a case of the inkjet method, and a cleaning device required in a case of stereolithography (SLA).

[0029] Figs. 3A-1, 3A-2, and 3B illustrate examples of forming methods for carrying out "additive manufacturing" to which the present exemplary embodiment is applicable.

[0030] Fig. 3A-1 illustrates a method for forming the three-dimensional object based on the material sheet lamination method.

[0031] In this method, the forming unit 264 gradually forms an object 304 by additive manufacturing, by repeatedly layering a material sheet 310 on a stage 301 and radiating energy (light, heat, or the like) from an energy source 302. Fig. 3A-2 illustrates one material sheet 310. The material sheet 310 includes a structural material 312 containing the material and a support material 311. The structural material 312 is welded to structural material portions of the material sheets 310 stacked under and on itself by receiving the energy from the energy source 302. This leads to gradual completion of the ad-

ditive manufacturing object 304. The support material 311 is not welded to the additive manufacturing object 304, and is being layered on the stage 301 as a support 303 of the additive manufacturing object 304. For example, the support 303 is water-soluble, and can be removed by watering the support 303 portion when extracting the additive manufacturing object 304.

[0032] In the material sheet lamination method, the delayed join process proposed by the exemplary embodiments of the present invention can be realized by forming the structural material 312 corresponding to the object to be additionally formed at the support material 311 portion of the material sheet 310 corresponding to the object being formed.

[0033] Fig. 3B illustrates a method for additive manufacturing of the three-dimensional object based on the stereolithography method.

[0034] In this method, the forming unit 264 gradually forms the object 304 by additive manufacturing, by repeatedly layering a material (ultraviolet-curable resin or the like) on the stage 301 and radiating energy (ultraviolet from a laser, or the like) from the energy source 302. In this case, a portion unexposed to the ultraviolet ends up remaining on the stage 301 without being cured. Accordingly, the uncured material serves as the support for the additive manufacturing object 304 as remaining there. When the forming process is completed, the object 304 can be extracted alone by removing the uncured portion.

[0035] In the formation method illustrated in Fig. 3B, the delayed join process proposed by the exemplary embodiments of the present invention can be realized by being adding coordinate information corresponding to the object to be additionally formed to coordinate information corresponding to the object being formed as a position to be irradiated with the energy.

[0036] Fig. 4 illustrates an example of a module configuration of software of the apparatuses according to the present exemplary embodiment.

[0037] The present drawing is a conceptual drawing for illustrating the present exemplary embodiment, and each module is a module exemplarily depicted so as to serve as a performer of the process realized by the CPU 201 or the CPU 252 executing codes of the above-described program for the forming control.

[0038] A reception unit 401 receives the instruction for the delayed join process and the forming data targeted for the delayed join process. The forming data includes, for example, a data file in the Standard Triangulated Language (STL) format that corresponds to three-dimensional model data. The present exemplary embodiment is applicable even when the forming data is data in another format ((the Wavefront Object (OBJ) format or the like) supportable by the PC 103 or the forming apparatus 102, which controls the three-dimensional object formation. Besides that, the present exemplary embodiment is also applicable even when the forming data is data in Additive Manufacturing File Format (AMF). Further, forming commands generated from the model data (data

specifying a coordinate position targeted for the forming on each layer surface of the additive manufacturing object) may be used as the forming data.

[0039] A forming management unit 402 determines, for example, information about the object being currently formed by the forming apparatus 102, and whether the delayed join process can be performed.

[0040] A device information management unit 403 manages performance information of the forming apparatus 102, especially, information including, for example, a size of an entire space where the formation can be carried out on the stage.

[0041] A forming control unit 404 controls the forming instruction according to the forming method based on the forming data. More specifically, the forming control unit 404 instructs the forming unit 264 to form the three-dimensional object via the controller 263.

[0042] A notification unit 405 issues notifications that convey messages indicating a start and completion of the formation, a failure, a cancellation of the delayed join process, and the like with use of the display 209 or the operation unit 256. The notification unit 405 can also notify an external apparatus of these messages via the network 101.

[0043] Fig. 5 is a flowchart illustrating a procedure of the delayed join process proposed by the exemplary embodiments of the present invention. The present flowchart illustrates the process realized by the CPU 201 or the CPU 252 executing the above-described program for the forming control. This means that all of the process steps in the present flowchart are performed by the PC 103 or the forming apparatus 102.

[0044] For example, it is also possible that the individual steps are performed by being divided between the PC 103 and the forming apparatus 102, like the PC 103 performing only steps involving a notification process, such as steps S505, S508, S510, and S512, which will be described below. In the case where the PC 103 performs the notification process, at least a program for realizing the configuration regarding the notification unit 405 is supposed to be stored and executed therein. The notification by the notification unit 405 is mainly assumed to be achieved by a display on the operation unit 256 of the forming apparatus 102 or the display 209 of the PC 103, but may be issued to the external apparatus in the network 101 with use of an electronic mail or the like.

[0045] In step S501, the reception unit 401 receives the instruction for the delayed join process and the forming data targeted for the delayed join process. For example, the user specifies a forming apparatus to be set as a target where the delayed join process is performed from a pull-down menu 702 via a setting screen 701 illustrated in Fig. 7A. The forming apparatus 102 is configured to allow the user to select the forming apparatus currently carrying out the formation among a plurality of pre-registered forming apparatuses capable of performing the delayed join process. The user can further specify various kinds of parameters regarding the forming process

as forming settings 703 on the setting screen 701. Further, the user can specify a forming setting specific to the selected forming apparatus on a different screen or the like by pressing an advanced setting button 704. When an ENTER button is pressed on the setting screen 701, the instruction for the delayed join process is issued. The setting screen 701 is displayed on the operation unit 256 of the forming apparatus 102 or the display 209 of the PC 103.

[0046] In step S502, the forming management unit 402 identifies a forming position with respect to the object being currently formed. The position can be identified by acquiring the coordinate information on the stage of the forming unit 264 via the forming control unit 404. In step S503, the forming management unit 402 calculates a free space where the formation can be carried out in addition to the object being currently formed on the stage of the forming apparatus 102.

[0047] Now, Figs. 6A and 6B illustrate examples of the forming position in the delayed join process. A method for calculating the free space that is performed by the forming management unit 402 will be described with reference to Figs. 6A and 6B.

[0048] Information indicating the forming position identified in step S502 and information about the entire space where the forming apparatus 102 can carry out the formation on the stage, which is managed by the device information management unit 403, are used for the calculation.

[0049] Fig. 6A illustrates a first example of a forming pattern according to which the delayed join process is performed.

[0050] In this pattern, a three-dimensional space 605 that would contain the entire additive manufacturing object when the object being formed is completed will be secured in advance on the stage, and the object targeted for the delayed join process will be formed within a space 606 other than the space 605 on the stage.

[0051] A stage 601 is positioned inside the forming unit 264, and the above-described material or material sheet is layered thereon. The entire space where the forming apparatus 102 can carry out the formation on the stage 601 is defined by a three-dimensional space formed by the stage 601 and a height 602.

[0052] The three-dimensional space 605 is a space that would contain the entire additive manufacturing object when the object being formed is completed. Then, an additive manufacturing object 603 is an already formed object at this point. An object 610 virtually indicates an object before the object is formed. Positional information 604 indicates the forming position of the object being currently formed that is being irradiated with the energy. The positional information 604 should include at least coordinate data indicating a height in a direction perpendicular to a horizontal surface of the stage 601 where the consumable material is layered.

[0053] A three-dimensional space 606 is a space prepared above the stage 601 that does not overlap the por-

tion where the three-dimensional space 605 is set up on the stage 601. A coordinate indicating a height of a bottom surface of the three-dimensional space 606 in the direction perpendicular to the horizontal surface of the stage 601 is set to a higher value than the coordinate indicating the height of the positional information 604. The setting of the value is determined according to, for example, a formation speed of the forming apparatus 102. More specifically, the coordinate of the bottom surface of the three-dimensional space 606 in the height direction above the stage 601 is set to a value acquired by adding a predetermined value that allows a command to be additionally issued in time in step S507, which will be described below, to the coordinate of the positional information 604 in the height direction.

[0054] The forming management unit 402 manages an area (a width and a depth) of the portion on the stage 601 where the three-dimensional space 605 is set up. Therefore, the forming management unit 402 can acquire a width, a depth, and a height 607 of the three-dimensional space 606 because of the determination of the coordinate indicating the height of the bottom surface of the three-dimensional space 606 in the direction perpendicular to the horizontal surface of the stage 601. In other words, the forming management unit 402 can calculate the free space for the delayed join process in step S503.

[0055] A three-dimensional space 608 is a space on the stage 601 that is located below the three-dimensional space 606, and the space 608 is filled with the consumable material, which works as the support when the additive manufacturing object 603 is formed. More specifically, in the case of the material sheet lamination method, the three-dimensional space 608 works as the support 303 formed by the support material 311. Alternatively, in the case of the above-described stereolithography method, the three-dimensional space 608 is filled with the material uncured by the ultraviolet that works as the support. This means that, in the three-dimensional space 606, the object is formed above them working as the support.

[0056] The delayed join process according to the forming pattern 1 illustrated in Fig. 6A leads to parallel formation of at least a part of each of the plurality of target objects from halfway through one forming process.

[0057] Fig. 6B illustrates a second example of the forming pattern according to which the delayed join process is performed.

[0058] In this pattern, the object targeted for the delayed join process will be additionally formed in the space 606 above the three-dimensional space 605 that would contain the entire additive manufacturing object when the object being formed is completed. The additive manufacturing method can shorten a forming time period by adjusting, for example, an orientation of the object so as to reduce the height of the target object on the stage 601. In the case where such control is performed, a space that allows the additional formation remains above the object. The present forming pattern realizes the delayed join process by utilizing the space.

[0059] As described above, the stage 601 is positioned inside the forming unit 264, and the above-described material or material sheet is layered thereon. The entire space where the forming apparatus 102 can carry out the formation on the stage 601 is defined by the three-dimensional space designated by the stage 601 and the height 602.

[0060] The three-dimensional space 605 is the space that would contain the entire additive manufacturing object when the object being formed is completed. Then, the additive manufacturing object 603 is the already formed object at this point. The object 610 virtually indicates the object before the object is formed.

[0061] The coordinate indicating the height of the bottom surface of the three-dimensional space 606 in the direction perpendicular to the horizontal surface of the stage 601 matches a top surface of the three-dimensional space 605, whereby the height 607 of the three-dimensional space 606 can be acquired as a difference from the height 602 of the entire space. The area (the width and the depth) of the three-dimensional space 606 matches the three-dimensional space 605. In other words, the forming management unit 402 can calculate the free space for the delayed join process in step S503.

[0062] The delayed join process according to the forming pattern 2 illustrated in Fig. 6B leads to sequential formation of the plurality of target objects during one forming process.

[0063] Now, in the present exemplary embodiment, the three-dimensional space 606 is identified by the above-described calculation method, but the free space can also be identified by another method. More specifically, one of other possible methods is to fixedly lay out the forming position of the object being formed and manage this layout, and, further, acquire the coordinate of the height in the direction perpendicular to the horizontal surface of the above-described stage 601 from, for example, an elapsed time period from the start of the formation. The three-dimensional space 606 is identified from these pieces of information. A method other than the examples discussed herein can also be used as the method for identifying the three-dimensional space 606.

[0064] In step S504, the forming management unit 402 determines whether the object corresponding to the model data targeted for the delayed join process can be formed in addition to the object being currently formed (whether the delayed join process can be performed). If the forming management unit 402 determines that the delayed join process can be performed (YES in step S504), the processing proceeds to step S506. If the forming management unit 402 determines that the delayed join process cannot be performed (NO in step S504), the processing proceeds to step S505.

[0065] In the preferred embodiment, as one of determinations in step S504, the forming management unit 402 determines whether the corresponding object can be contained in the free space available for the additional formation that has been calculated in step S503, and will

determine that the delayed join process can be performed only if the object can be contained. Further, as another determination, the forming management unit 402 determines whether the delayed join process can be performed by checking whether the forming settings set via the setting screen 701 do not conflict with the forming settings of the object being currently formed. If a type of the material or a thickness of the stacked layer (a layer pitch) is not the same between the respective forming settings, the forming management unit 402 determines that the delayed join process cannot be performed. If there is not such a setting as the one causing a conflict, the forming management unit 402 can determine that the delayed join process can be performed.

[0066] In step S505, the notification unit 405 issues a notification indicating that the delayed join process cannot be performed. In the present example, along therewith, the notification unit 405 also issues a notification indicating that the size of the object corresponding to the model data targeted for the delayed join process cannot be formed in the space available for the formation as a reason why the delayed join process cannot be performed.

[0067] In step S506, the forming management unit 402 generates the forming control commands based on the forming data targeted for the delayed join process. In step S507, the forming management unit 402 instructs the forming control unit 404 to engage in the formation according to the generated forming control command. For example, the forming control command refers to a command specifying the target position on each layer surface when the object is formed by additive manufacturing at the forming unit 264. As for the delayed join process, the coordinate of the forming position on each layer surface is supposed to be specified in such a manner that the completed object can be contained within the above-described three-dimensional space 606. The forming control unit 404 controls the forming process at the forming unit 264 via the controller 263 in such a manner that the object is formed according to the forming control command issued here in addition to the forming control command for the object being formed.

[0068] In step S508, the notification unit 405 issues a notification indicating the start of the delayed join process.

[0069] In step S509, the forming management unit 402 determines whether the delayed join process procedure has been completed. The forming management unit 402 can manage a progress of the delayed join process and an error in the formation by receiving data regarding the progress of the formation via the forming control unit 404. If the forming management unit 402 can determine that the delayed join process procedure has been completed (YES in step S509), the processing proceeds to step S510. If the forming management unit 402 cannot determine that the delayed join process procedure has been completed (NO in step S509), the processing proceeds to step S511. In step S510, the notification unit 405 issues

a notification indicating that the delayed join process procedure has been completed.

[0070] In step S511, the forming management unit 402 determines whether the delayed join process has failed. If the forming management unit 402 determines that the delayed join process has failed (YES in step S511), the processing proceeds to step S512. If the forming management unit 402 cannot determine that the delayed join process has failed (NO in step S511), the processing returns to step S509. In step S512, the notification unit 405 issues a notification indicating that the delayed join process has failed.

[0071] Further, the system can also be configured to allow the instruction for the delayed join process via Figs. 7A, 7B, and 7C to be issued only toward the forming apparatus performing the forming process.

[0072] Now, a timing at which the instruction for the delayed join process proposed by the exemplary embodiments of the present invention can be issued will be described with reference to Fig. 9.

[0073] The forming process at the forming apparatus 102 is started according to the forming instruction from the PC 103 or the forming apparatus 102. In the forming process, first, a pre-process (1) including warming up the forming unit 264 (an adjustment of a position of the stage, an adjustment of a temperature, and the like) is performed. After that, actual additive manufacturing (2) is carried out. Then, after the formation of the object itself is completed, a post-process (3) is performed for the purpose of, for example, safely extracting the additive manufacturing object, and then the forming process is completed. The completion notification in step S510 is issued according to the completion of the entire forming process.

[0074] The user is supposed to perform a post-process such as the work of extracting the object and the removal of the support according to the completion notification.

[0075] The instruction for the delayed join process proposed by the exemplary embodiments of the present invention is supposed to be received during from the pre-process (1) and the additive manufacturing (2).

[0076] Only a type of apparatus capable of carrying out the additional formation during the post-process can receive the instruction for the delayed join process and perform the delayed join process during a time period from the post-process (3) to the completion of the forming process.

[0077] According to the first exemplary embodiment, it becomes possible to perform the delayed join process proposed by the exemplary embodiments of the present invention. On the other hand, the execution of the delayed join process results in a delayed completion time of the object already in the middle of being formed. Further, the plurality of formed objects is formed at distant positions, which complicates the post-process such as the extraction of the objects.

[0078] Therefore, a second exemplary embodiment further proposes a mechanism for allowing appropriate execution of the delayed join process. The second ex-

emplary embodiment has a system configuration and the like approximately similar to the first exemplary embodiment, and therefore will be described omitting descriptions of such similar features and focusing only on differences from the first exemplary embodiment.

[0079] Fig. 8 illustrates a forming setting screen provided by the forming management unit 402 according to the second exemplary embodiment. A setting screen 801 is different from the screen illustrated in Fig. 7A and is a setting screen for issuing the forming instruction to a forming apparatus that is not carrying out the formation. The setting screen 801 is displayed on the operation unit 256 of the forming apparatus 102 or the display 209 of the PC 103.

[0080] The user can select the forming apparatus with which the user wants to carry out the formation with use of a pull-down menu 802. Further, the user can configure the various kinds of forming settings on the setting screen 801, similarly to Figs. 7A, 7B, and 7C.

[0081] In a delayed join process setting field 803, the user can set, for example, whether to permit the delayed join process.

[0082] In a pull-down menu 804, the user can set in advance whether to accept (permit) the delayed join process for another object in the middle of the forming process for the object set as the target on the present setting screen 801. Specifying "OK" in the menu 804 permits the delayed join process to be performed. Specifying "NG" in the menu 804 prohibits the delayed join process from being performed.

[0083] A check box 805 is used to determine whether to set a completion time period of the forming process for the object set as the target on the present setting screen 801. If the check box 805 is checked, the user can set a time period to be taken until the formation is completed.

[0084] In a pull-down menu 806, the user sets a desired time period to be taken until the formation is completed. At this time, at least how long it will take for the forming process as the forming time period is predicted from the shape of the object set as the target, the parameters of the forming settings, and the like. Then, the predicted forming time period is set in the menu 806 as default. The user intending to accept the delayed join process in advance is supposed to set a relatively long forming time period by operating the menu 806. The forming time period set here does not include a time period for the post-process regarding the extraction of the object.

[0085] In the present exemplary embodiment, a determination process based on the setting specified in the menu 806 is added in step S504 illustrated in Fig. 5 in addition to the first exemplary embodiment.

[0086] More specifically, the forming management unit 402 recalculates and predicts the forming time period to be taken when, together with the object being formed, the object targeted for the delayed join process is started to be formed at the same time from halfway, from the shape of the target object for the delayed join process,

the parameters of the forming settings, and/or the like. Then, the forming management unit 402 determines whether the procedure of the delayed join process can be completed within the forming time period specified in the menu 806 from the start of the formation of the object being currently formed based on the recalculated time period. If the forming management unit 402 determines that the delayed join process cannot be completed, the processing will proceed from step S504 to step S505.

[0087] If the delayed join process is specified to be permitted on the setting screen 801, the forming position of the targeted object is controlled to be displaced closer to a corner on the stage. This control increases a possibility that the delayed join process according to the forming pattern described with reference to Fig. 6A is determined to be able to be performed. Further, similarly, the second exemplary embodiment can also include control of adjusting, for example, the orientation of the object so as to minimize the height of the targeted object in consideration of the forming pattern described with reference to Fig. 6B.

(First Exemplary Application)

[0088] The examples of the forming method to which the delayed join process proposed by the exemplary embodiments of the present invention is applicable also include the subtractive manufacturing method, and stereolithography, powder sintering, and powder binding, which belong to the above-described additive manufacturing method, besides the examples illustrated in Figs. 3A-1, 3A-2, and 3B. As stereolithography, there are a method using powered resin and a method using liquid as the material. For powder sintering, metallic powder, resin, and the like can be used as the material. For powder binding, for example, a plaster material can be cured and layered with use of a binder.

[0089] On the other hand, it is difficult to apply the delayed join process proposed by the exemplary embodiments of the present invention with respect to a forming method that does not move the stage where the object is set up but moves a head or the like for layering the material in the direction perpendicular to the horizontal surface of the stage. However, even for such a forming method, configuring the apparatus to also move the stage divided in advance in the perpendicular direction at the time of the delayed join process allows an additional object to be formed by the delayed join process on the stage. Further, control such as also forming the support material in advance on the stage where no object is formed in preparation for the delayed join process allows an additional object to be formed by the delayed join process on the support material.

(Second Exemplary Application)

[0090] In Figs. 6A and 6B, the three-dimensional space 605 that would contain the entire additive manufacturing

object when the object being formed is completed is secured as a cuboid. However, the three-dimensional space 605 that would contain the entire additive manufacturing object when the object being formed is completed can also be secured in a shape such as a cylindrical shape, a triangular prism shape, a conical shape, a triangular pyramid shape according to the shape of the additive manufacturing object. In such a case, a larger space can be secured as the three-dimensional space 606 for the delayed join process, which further facilitates the application of the delayed join process.

Other Embodiments

[0091] Embodiment(s) of the present invention can also be realized by a computer of a system or apparatus that reads out and executes computer executable instructions (e.g., one or more programming codes) recorded on a storage medium (which may also be referred to more fully as a 'non-transitory computer-readable storage medium') to perform the functions of one or more of the above-described embodiment(s) and/or that includes one or more circuits (e.g., application specific integrated circuit (ASIC)) for performing the functions of one or more of the above-described embodiment(s), and by a method performed by the computer of the system or apparatus by, for example, reading out and executing the computer executable instructions from the storage medium to perform the functions of one or more of the above-described embodiment(s) and/or controlling the one or more circuits to perform the functions of one or more of the above-described embodiment(s). The computer may comprise one or more processors (e.g., central processing unit (CPU), micro processing unit (MPU)) and may include a network of separate computers or separate processors to read out and execute the computer executable instructions. The computer executable instructions may be provided to the computer, for example, from a network or the storage medium. The storage medium may include, for example, one or more of a hard disk, a random-access memory (RAM), a read only memory (ROM), a storage of distributed computing systems, an optical disk (such as a compact disc (CD), digital versatile disc (DVD), or Blu-ray Disc (BD)TM), a flash memory device, a memory card, and the like.

[0092] While the present invention has been described with reference to examples and embodiments of the invention, it to be understood that the invention is not limited to the disclosed examples and embodiments of the invention, but only by the enclosed claims.

Claims

1. A forming control apparatus for controlling a forming process performed by a forming unit (264) arranged to form a three-dimensional object, the forming control apparatus comprising:

a reception means (401) arranged to receive, during the forming process for a first object performed by the forming unit (264), an instruction to form a second object, which is different from the first object, and forming data corresponding to the second object;

a specifying means (403) arranged to specify a third three-dimensional space where an object can be additionally formed by the forming unit (264), based on a first three-dimensional space of the forming unit (264) where an object can be formed and a second three-dimensional space required to form the first object in the first three-dimensional space;

a determination means (402) arranged to determine whether the second object can be formed in the third three-dimensional space;

an instruction means (404) arranged to issue, to the forming unit (264), a forming control command for forming the second object in the third three-dimensional space based on the forming data received by the reception means (401) according to the determination by the determination means (402), wherein, parallel to forming the first object by the forming unit (264), at least part of the second object is formed by the forming unit (264) in the third three-dimensional space in accordance with the issued forming control command; and

a notification means (405) for issuing a completion notification in a case where the forming process for the first object and the second object by the forming unit (264) is completed;

characterized in that,

the determination means (402) is arranged to further determine whether a forming layer pitch included in a forming setting of the first object is the same as a forming layer pitch included in a forming setting of the second object or not in order to determine whether the second object can be formed additionally or not,

the notification means (405) is arranged to further issue, in a case where the forming layer pitch included in the forming setting of the first object is not the same as the forming layer pitch included in the forming setting of the second object, a notification indicating that the second object cannot be formed, without issuing the forming control command for forming the second object in the third three-dimensional space based on the forming data received by the reception means (401); and

the instruction means (404) is arranged to further issue, to the forming unit (264), the forming control command for forming the second object in the third three-dimensional space based on the forming data received by the reception means (401) in a case where the determination

- means (402) determines that the second object can be formed in the third three-dimensional space and where the forming layer pitch included in the forming setting of the first object is the same as the forming layer pitch included in the forming setting of the second object.
2. The forming control apparatus according to claim 1, wherein, in a case where the determination means (402) determines that the second object cannot be formed in the third three-dimensional space, the instruction means (404) is arranged not to issue the forming control command based on the forming data and the notification means (405) is arranged to issue a notification indicating that the second object cannot be formed.
 3. The forming control apparatus according to claim 1 or 2, wherein the determination means (402) is arranged to further determine whether a type of a material included in the forming setting of the first object is the same as a type of a material included in the forming setting of the second object or not in order to determine whether the second object can be formed additionally or not, the notification means (405) is arranged to issue, in a case where the type of the material included in the forming setting of the first object is not the same as the type of the material included in the forming setting of the second object, a notification indicating that the second object cannot be formed, without issuing the forming control command for forming the second object in the third three-dimensional space based on the forming data received by the reception means (401).
 4. The forming control apparatus according to any one of claims 1 to 3, further comprising a setting means (701, 801) for setting whether to permit another object to be additionally formed while the first object is being formed, when an instruction to form the first object is issued.
 5. The forming control apparatus according to any one of claims 1 to 4, wherein, in a case where the forming process for the first object and the second object is completed by a time based on a time period specified when an instruction to form the first object is issued by which the formation should be completed, the determination means is arranged to further determine that the second object can be additionally formed, and wherein, in a case where the determination means determines that the second object cannot be additionally formed, the instruction means does not issue the forming control command based on the forming data and the notification means issues a notification indicating that the second object cannot be formed.
 6. The forming control apparatus according to any one of claims 1 to 5, wherein the forming unit (264) has a configuration in which, in a direction perpendicular to a horizontal surface of a stage (301) where a consumable material including a material for forming the object is layered, the stage (301) is arranged to move at the time of the forming process.
 7. The forming control apparatus according to any one of claims 1 to 5, wherein the forming unit (264) is arranged to perform the forming process by repeatedly layering a material sheet, the material sheet including a structural material, which is formed into an additive manufacturing object by being welded, and a support material.
 8. A control method comprising:
 - a reception step of receiving, during a forming process for a first object performed by a forming unit for forming a three-dimensional object, an instruction to form a second object, which is different from the first object, and forming data corresponding to the second object;
 - a specifying step of specifying a third three-dimensional space where an object can be additionally formed by the forming unit, based on a first three-dimensional space of the forming unit where an object can be formed and a second three-dimensional space required to form the first object in the first three-dimensional space;
 - a determination step of determining whether the second object can be formed in the third three-dimensional space;
 - an instruction step of issuing, to the forming unit (264), a forming control command for forming the second object in the third three-dimensional space based on the forming data received by the reception means (401) according to the determination by the determination means (402), wherein, parallel to forming the first object by the forming unit (264), at least part of the second object is formed by the forming unit (264) in the third three-dimensional space in accordance with the issued forming control command; and
 - a notification step of issuing a completion notification in a case where the forming process for the first object and the second object by the forming unit (264) is completed;

characterized in that,
the determination step determines whether a forming layer pitch included in a forming setting of the first object is the same as a forming layer pitch included in a forming setting of the second object or not in order to determine whether the second object can be formed additionally or not,

- the notification step issues, in a case where the forming layer pitch included in the forming setting of the first object is not the same as the forming layer pitch included in the forming setting of the second object, a notification indicating that the second object cannot be formed, without issuing the forming control command for forming the second object in the third three-dimensional space based on the forming data received by the reception means (401); and
- the instruction step issues, to the forming unit (264), the forming control command for forming the second object in the third three-dimensional space based on the forming data received by the reception means (401) in a case where the determination step determines that the second object can be formed in the third three-dimensional space and where the forming layer pitch included in the forming setting of the first object is the same as the forming layer pitch included in the forming setting of the second object.
9. The control method according to claim 8, wherein, in a case where it is determined that the second object cannot be formed in the third three-dimensional space, the forming control command based on the forming data is not issued and a notification indicating that the second object cannot be formed is issued.
 10. The control method according to claim 8 or 9, wherein, in the determination step, whether a type of a material included in the forming setting of the first object is the same as a type of a material included in the forming setting of the second object or not is determined in order to determine whether the second object can be formed additionally or not, the notification step issues, in a case where the type of the material included in the forming setting of the first object is not the same as the type of the material included in the forming setting of the second object, a notification indicating that the second object cannot be formed, without issuing the forming control command for forming the second object in the third three-dimensional space based on the forming data received by the reception means (401).
 11. The control method according to any one of claims 8 to 10, further comprising a setting step of setting whether to permit another object to be additionally formed while the first object is being formed, when an instruction to form the first object is issued.
 12. The control method according to any one of claims 8 to 11, wherein, in the determination step, in a case where the forming process for the first object and the second object is completed by a time based on a time

period specified when an instruction to form the first object is issued by which the formation should be completed, it is further determined that the second object can be additionally formed, and wherein, in a case where it is determined that the second object cannot be additionally formed, the forming control command based on the forming data is not issued and the notification indicating that the second object cannot be formed is issued.

13. A computer program comprising instructions that, when executed by a forming control apparatus, cause the forming control apparatus to execute the control method according to any one of claims 8 to 12.

Patentansprüche

1. Formungssteuervorrichtung zum Steuern eines durch eine Formungseinheit (264) durchgeführten Formungsvorgangs, die ausgebildet ist zum Formen eines dreidimensionalen Objekts, wobei die Formungssteuervorrichtung umfasst:
eine Empfangseinrichtung (401), die ausgebildet ist, während des durch die Formungseinheit (264) durchgeführten Formungsvorgangs für ein erstes Objekt, zum Empfangen einer Anweisung ein vom ersten Objekt verschiedenes zweites Objekt zu formen, und von dem zweiten Objekt entsprechenden Formungsdaten:

eine Spezifizierungseinrichtung (403), die ausgebildet ist zum Spezifizieren eines dritten dreidimensionalen Raums, in dem ein Objekt zusätzlich durch die Formungseinheit (264) geformt werden kann, basierend auf einem ersten dreidimensionalen Raum der Formungseinheit (264), in dem ein Objekt geformt werden kann und einem zum Formen des ersten Objekts im ersten dreidimensionalen Raum erforderlichen zweiten dreidimensionalen Raum;
eine Bestimmungseinrichtung (402), die ausgebildet ist zum Bestimmen, ob das zweite Objekt im dreidimensionalen Raum geformt werden kann;

eine Anweisungseinrichtung (404), die ausgebildet ist zum Ausgeben eines Formungssteuerbefehls an die Formungseinheit (264) zum Formen des zweiten Objekts im dreidimensionalen Raum, basierend auf den durch die Empfangseinrichtung (401) empfangenen Formungsdaten gemäß der Bestimmung durch die Bestimmungseinrichtung (402), wobei, parallel zum Formen des ersten Objekts durch die Formungseinheit (264) zumindest ein Teil des zweiten Objekts durch die Formungseinheit (264) im dritten dreidimensionalen Raum gemäß dem

ausgegebenen Formungssteuerbefehl geformt wird; und

eine Benachrichtigungseinrichtung (405) zum Ausgeben einer Abschlussbenachrichtigung, falls der Formungsvorgang für das erste und das zweite Objekt durch die Formungseinheit (264) abgeschlossen ist;

dadurch gekennzeichnet, dass,

die Bestimmungseinrichtung (402) ausgebildet ist zum ferner Bestimmen, ob eine in einer Formungseinstellung des ersten Objekts enthaltene Formungsschichthöhe dieselbe ist wie eine in einer Formungseinstellung des zweiten Objekts enthaltene Formungsschichthöhe oder nicht, um zu bestimmen, ob das zweite Objekt zusätzlich geformt werden kann oder nicht, die Benachrichtigungseinrichtung (405) ausgebildet ist zum ferner Ausgeben, falls die in der Formungseinstellung des ersten Objekts enthaltene Formungsschichthöhe nicht dieselbe ist wie die in der Formungseinstellung des zweiten Objekts enthaltene Formungsschichthöhe, einer Benachrichtigung, die angibt, dass das zweite Objekt nicht geformt werden kann, ohne Ausgeben des Formungssteuerbefehls zum Formen des zweiten Objekts im dritten dreidimensionalen Raum, basierend auf den durch die Empfangseinrichtung (401) empfangenen Formungsdaten; und

die Anweisungseinrichtung (404) ausgebildet ist zum außerdem Ausgeben des Formungssteuerbefehls an die Formungseinheit (264) zum Formen des zweiten Objekts im dritten dreidimensionalen Raum, basierend auf den durch die Empfangseinrichtung (401) empfangenen Formungsdaten, falls die Bestimmungseinrichtung (402) bestimmt, dass das zweite Objekt im dritten dreidimensionalen Raum geformt werden kann und in dem die in der Formungseinstellung des ersten Objekts enthaltene Formungsschichthöhe dieselbe ist wie die in der Formungseinstellung des zweiten Objekts enthaltene Formungsschichthöhe.

2. Formungssteuervorrichtung nach Anspruch 1, wobei, falls die Bestimmungseinrichtung (402) bestimmt, dass das zweite Objekt nicht im dreidimensionalen Raum geformt werden kann, die Anweisungseinrichtung (404) ausgebildet ist, den auf den Formungsdaten basierenden Formungssteuerbefehl nicht auszugeben und die Benachrichtigungseinrichtung (405) ausgebildet ist, eine Benachrichtigung auszugeben, die angibt, dass das zweite Objekt nicht geformt werden kann.
3. Formungssteuervorrichtung nach Anspruch 1 oder 2, wobei die Bestimmungseinrichtung (402) ausgebil-

det ist zum ferner Bestimmen, ob ein in der Formungseinstellung des ersten Objekts enthaltener Materialtyp derselbe ist wie ein in der Formungseinstellung des zweiten Objekts enthaltener Materialtyp oder nicht, um zu bestimmen, ob das zweite Objekt zusätzlich geformt werden kann oder nicht, die Benachrichtigungseinrichtung (405) ausgebildet ist zum Ausgeben, falls der in der Formungseinstellung des ersten Objekts enthaltene Materialtyp nicht derselbe ist wie der in der Formungseinstellung des zweiten Objekts enthaltene Materialtyp, einer Benachrichtigung, die angibt, dass das zweite Objekt nicht geformt werden kann, ohne Ausgeben des Formungssteuerbefehls zum Formen des zweiten Objekts im dritten dreidimensionalen Raum, basierend auf den durch die Empfangseinrichtung (401) empfangenen Formungsdaten.

4. Formungssteuervorrichtung nach einem der Ansprüche 1 bis 3, ferner umfassend eine Einstellungseinrichtung (701, 801) zum Einstellen, ob ein anderes Objekt zusätzlich geformt werden darf während das erste Objekt geformt wird, wenn eine Anweisung zum Formen des ersten Objekts ausgegeben wird.
5. Formungssteuervorrichtung nach einem der Ansprüche 1 bis 4, wobei, falls der Formungsvorgang für das erste und das zweite Objekt zu einem Zeitpunkt abgeschlossen ist, der auf einer Zeitspanne basiert, die spezifiziert wird wenn eine Anweisung zum Formen des ersten Objekts ausgegeben wird, nach dem das Formen abgeschlossen sein sollte, die Bestimmungseinrichtung ausgebildet ist zum ferner Bestimmen, dass das zweite Objekt zusätzlich geformt werden kann, und wobei, falls die Bestimmungseinrichtung bestimmt, dass das zweite Objekt nicht zusätzlich geformt werden kann, die Anweisungseinrichtung den auf den Formungsdaten basierenden Formungssteuerbefehl nicht ausgibt und die Benachrichtigungseinrichtung eine Benachrichtigung ausgibt, die angibt, dass das zweite Objekt nicht geformt werden kann.
6. Formungssteuervorrichtung nach einem der Ansprüche 1 bis 5, wobei die Formungseinheit (264) eine Konfiguration aufweist, bei der in einer Richtung senkrecht zu einer horizontalen Fläche einer Platte (301), wo Material zum Formen des Objekts enthaltendes Verbrauchsmaterial geschichtet wird, die Platte (301) ausgebildet ist, sich zum Zeitpunkt des Formungsvorgangs zu bewegen.
7. Formungssteuervorrichtung nach einem der Ansprüche 1 bis 5, wobei die Formungseinheit (264) ausgebildet ist zum Durchführen des Formungsvorgangs durch wiederholtes Schichten eines Materialbogens, wobei dieser ein strukturelles Material, das durch Schweißen zu einem zusätzlichen Herstel-

lungsobjekt geformt wird, sowie ein Trägermaterial enthält.

8. Steuerverfahren, umfassend:

einen Empfangsschritt des Empfangens, während eines durch eine Formungseinheit zum Formen eines dreidimensionalen Objekts durchgeführten Formungsvorgangs für ein erstes Objekt, einer Anweisung zum Formen eines vom ersten Objekt verschiedenen zweiten Objekts, und von dem zweiten Objekt entsprechenden Formungsdaten;

einen Spezifizierungsschritt des Spezifizierens eines dritten dreidimensionalen Raums, in dem ein Objekt zusätzlich durch die Formungseinheit geformt werden kann, basierend auf einem ersten dreidimensionalen Raum der Formungseinheit, in dem ein Objekt geformt werden kann und einem zum Formen des ersten Objekts im ersten dreidimensionalen Raum erforderlichen zweiten dreidimensionalen Raum;

einen Bestimmungsschritt des Bestimmens, ob das zweite Objekt im dreidimensionalen Raum geformt werden kann;

einen Anweisungsschritt des Ausgebens eines Formungssteuerbefehls an die Formungseinheit (264) zum Formen des zweiten Objekts im dreidimensionalen Raum basierend auf den durch die Empfangseinrichtung (401) empfangenen Formungsdaten gemäß der Bestimmung durch die Bestimmungseinrichtung (402), wobei, parallel zum Formen des ersten Objekts durch die Formungseinheit (264) zumindest ein Teil des zweiten Objekts durch die Formungseinheit (264) im dritten dreidimensionalen Raum gemäß dem ausgegebenen Formungssteuerbefehl geformt wird; und

einen Benachrichtigungsschritt des Ausgebens einer Abschlussbenachrichtigung, falls der Formungsvorgang für das erste und das zweite Objekt durch die Formungseinheit (264) abgeschlossen ist;

gekennzeichnet dadurch, dass,

der Bestimmungsschritt bestimmt, ob eine in einer Formungseinstellung des ersten Objekts enthaltene Formungsschichthöhe dieselbe ist wie eine in einer Formungseinstellung des zweiten Objekts enthaltene Formungsschichthöhe oder nicht, um zu bestimmen, ob das zweite Objekt zusätzlich geformt werden kann oder nicht, der Benachrichtigungsschritt, falls die in der Formungseinstellung des ersten Objekts enthaltene Formungsschichthöhe nicht dieselbe ist wie die in der Formungseinstellung des zweiten Objekts enthaltene Formungsschichthöhe, eine Benachrichtigung ausgibt, die angibt, dass das zweite Objekt nicht geformt werden kann, ohne

Ausgeben des Formungssteuerbefehls zum Formen des zweiten Objekts im dritten dreidimensionalen Raum, basierend auf den durch die Empfangseinrichtung (401) empfangenen Formungsdaten; und

der Anweisungsschritt den Formungssteuerbefehl an die Formungseinheit (264) ausgibt, zum Formen des zweiten Objekts im dritten dreidimensionalen Raum, basierend auf den durch die Empfangseinrichtung (401) empfangenen Formungsdaten, falls der Bestimmungsschritt bestimmt, dass das zweite Objekt im dritten dreidimensionalen Raum geformt werden kann und in dem die in der Formungseinstellung des ersten Objekts enthaltene Formungsschichthöhe dieselbe ist wie die in der Formungseinstellung des zweiten Objekts enthaltene Formungsschichthöhe.

9. Steuerverfahren nach Anspruch 8, wobei, falls bestimmt wird, dass das zweite Objekt nicht im dritten dreidimensionalen Raum geformt werden kann, der auf den Formungsdaten basierende Formungssteuerbefehl nicht ausgegeben wird und eine Benachrichtigung ausgegeben wird, die angibt, dass das zweite Objekt nicht geformt werden kann.

10. Steuerverfahren nach Anspruch 8 oder 9, wobei, im Bestimmungsschritt bestimmt wird, ob ein in der Formungseinstellung des ersten Objekts enthaltener Materialtyp derselbe ist wie ein in der Formungseinstellung des zweiten Objekts enthaltener Materialtyp oder nicht, um zu bestimmen, ob das zweite Objekt zusätzlich geformt werden kann oder nicht, der Benachrichtigungsschritt, falls der in der Formungseinstellung des ersten Objekts enthaltene Materialtyp nicht derselbe ist wie der in der Formungseinstellung des zweiten Objekts enthaltene Materialtyp, eine Benachrichtigung ausgibt, die angibt, dass das zweite Objekt nicht geformt werden kann, ohne Ausgeben des Formungssteuerbefehls zum Formen des zweiten Objekts im dritten dreidimensionalen Raum basierend auf den durch die Empfangseinrichtung (401) empfangenen Formungsdaten.

11. Steuerverfahren nach einem der Ansprüche 8 bis 10, ferner umfassend einen Einstellungsschritt des Einstellens, ob ein anderes Objekt zusätzlich geformt werden darf, während das erste Objekt geformt wird, wenn eine Anweisung zum Formen des ersten Objekts ausgegeben wird.

12. Steuerverfahren nach einem der Ansprüche 8 bis 11, wobei, im Bestimmungsschritt, falls der Formungsvorgang für das erste und zweite Objekt zu einem Zeitpunkt abgeschlossen ist, der auf einer Zeitspanne basiert, die spezifiziert wird wenn eine Anweisung

zum Formen des ersten Objekts ausgegeben wird, nach dem das Formen abgeschlossen sein sollte, ferner bestimmt wird, dass das zweite Objekt zusätzlich geformt werden kann, und wobei, falls bestimmt wird, dass das zweite Objekt nicht zusätzlich geformt werden kann, der auf den Formungsdaten basierende Formungssteuerbefehl nicht ausgegeben wird und die Benachrichtigung ausgegeben wird, die angibt, dass das zweite Objekt nicht geformt werden kann.

13. Computerprogramm, das Anweisungen umfasst, die bei Ausführung durch eine Formungssteuervorrichtung, diese dazu veranlassen, das Steuerverfahren nach einem der Ansprüche 8 bis 12 auszuführen.

Revendications

1. Appareil de commande de formation pour commander un processus de formation mis en œuvre par une unité de formation (264) conçue pour former un objet tridimensionnel, l'appareil de commande de formation comprenant :

un moyen de réception (401) conçu pour recevoir, pendant le processus de formation d'un premier objet mis en œuvre par l'unité de formation (264), une instruction ayant pour objet de former un second objet, qui est différent du premier objet, et des données de formation correspondant au second objet ;

un moyen de spécification (403) conçu pour spécifier un troisième espace tridimensionnel au niveau duquel un objet peut être formé additionnellement par l'unité de formation (264), sur la base d'un premier espace tridimensionnel de l'unité de formation (264) au niveau duquel un objet peut être formé et d'un deuxième espace tridimensionnel nécessaire pour former le premier objet dans le premier espace tridimensionnel ;

un moyen de détermination (402) conçu pour déterminer si le second objet peut être formé dans le troisième espace tridimensionnel ;

un moyen d'instruction (404) conçu pour émettre, à destination de l'unité de formation (264), une instruction de commande de formation ayant pour objet de former le second objet dans le troisième espace tridimensionnel sur la base des données de formation reçues par le moyen de réception (401) conformément à la détermination effectuée par le moyen de détermination (402), où, parallèlement à une formation du premier objet par l'unité de formation (264), au moins une partie du second objet est formée par l'unité de formation (264) dans le troisième espace tridimensionnel conformément à l'instruction

tion de commande de formation émise ; et un moyen de notification (405) destiné à émettre une notification d'achèvement dans un cas dans lequel le processus de formation du premier objet et du second objet par l'unité de formation (264) est achevé ;

caractérisé en ce que,

le moyen de détermination (402) est conçu pour déterminer en outre si un pas entre couches de formation compris dans un paramétrage de formation du premier objet est, ou non, le même qu'un pas entre couches de formation compris dans un paramétrage de formation du second objet de façon à déterminer si le second objet peut, ou non, être formé additionnellement, le moyen de notification (405) est conçu pour émettre en outre, dans un cas dans lequel le pas entre couches de formation compris dans le paramétrage de formation du premier objet n'est pas le même que le pas entre couches de formation compris dans le paramétrage de formation du second objet, une notification indiquant que le second objet ne peut pas être formé, sans émettre l'instruction de commande de formation ayant pour objet de former le second objet dans le troisième espace tridimensionnel sur la base des données de formation reçues par le moyen de réception (401) ; et

le moyen d'instruction (404) est conçu pour émettre en outre, à destination de l'unité de formation (264), l'instruction de commande de formation ayant pour objet de former le second objet dans le troisième espace tridimensionnel sur la base des données de formation reçues par le moyen de réception (401) dans un cas dans lequel le moyen de détermination (402) détermine que le second objet peut être formé dans le troisième espace tridimensionnel et dans lequel le pas entre couches de formation compris dans le paramétrage de formation du premier objet est le même que le pas entre couches de formation compris dans le paramétrage de formation du second objet.

2. Appareil de commande de formation selon la revendication 1, dans lequel, dans un cas dans lequel le moyen de détermination (402) détermine que le second objet ne peut pas être formé dans le troisième espace tridimensionnel, le moyen d'instruction (404) est conçu pour ne pas émettre l'instruction de commande de formation sur la base des données de formation et le moyen de notification (405) est conçu pour émettre une notification indiquant que le second objet ne peut pas être formé.
3. Appareil de commande de formation selon la revendication 1 ou 2, dans lequel le moyen de détermination (402) est con-

- çu pour déterminer en outre si un type d'un matériau compris dans le paramétrage de formation du premier objet est, ou non, le même qu'un type d'un matériau compris dans le paramétrage de formation du second objet de façon à déterminer si le second objet peut, ou non, être formé additionnellement, le moyen de notification (405) est conçu pour émettre, dans un cas dans lequel le type du matériau compris dans le paramétrage de formation du premier objet n'est pas le même que le type du matériau compris dans le paramètre de formation du second objet, une notification indiquant que le second objet ne peut pas être formé, sans émettre l'instruction de commande de formation ayant pour objet de former le second objet dans le troisième espace tridimensionnel sur la base des données de formation reçues par le moyen de réception (401).
4. Appareil de commande de formation selon l'une quelconque des revendications 1 à 3, comprenant en outre un moyen de paramétrage (701, 801) destiné à paramétrer s'il convient de permettre la formation additionnellement d'un autre objet pendant la formation du premier objet, lors de l'émission d'une instruction ayant pour objet de former le premier objet.
 5. Appareil de commande de formation selon l'une quelconque des revendications 1 à 4, dans lequel, dans un cas dans lequel le processus de formation du premier objet et du second objet est achevé en un temps basé sur une période de temps spécifiée lors de l'émission d'une instruction ayant pour objet de former le premier objet selon lequel la formation doit être achevée, le moyen de détermination est conçu pour déterminer en outre que le second objet ne peut pas être additionnellement formé, et dans lequel, dans un cas dans lequel le moyen de détermination détermine que le second objet ne peut pas être additionnellement formé, le moyen d'instruction n'émet pas l'instruction de commande de formation sur la base des données de formation et le moyen de notification émet une notification indiquant que le second objet ne peut pas être formé.
 6. Appareil de commande de formation selon l'une quelconque des revendications 1 à 5, dans lequel l'unité de formation (264) a une configuration selon laquelle, dans une direction perpendiculaire à une surface horizontale d'une platine (301) au niveau de laquelle est disposé en couches un matériau comprenant un matériau de formation de l'objet, la platine (301) est conçue pour se déplacer au moment du processus de formation.
 7. Appareil de commande de formation selon l'une quelconque des revendications 1 à 5, dans lequel

l'unité de formation (264) est conçue pour mettre en œuvre le processus de formation par une disposition en couches répétée d'une feuille de matériau, la feuille de matériau comprenant un matériau structural, qui est formée par soudage en un objet de fabrication additive, et d'un matériau de support.

8. Procédé de commande, comprenant :

une étape de réception consistant à recevoir, pendant un processus de formation d'un premier objet mis en œuvre par une unité de formation pour former un objet tridimensionnel, une instruction ayant pour objet de former un second objet, qui est différent du premier objet, et des données de formation correspondant au second objet ;
 une étape de spécification consistant à spécifier un troisième espace tridimensionnel au niveau duquel un objet peut être formé additionnellement par l'unité de formation, sur la base d'un premier espace tridimensionnel de l'unité de formation au niveau duquel peut être formé un objet et d'un deuxième espace tridimensionnel nécessaire pour former le premier objet dans le premier espace tridimensionnel ;
 une étape de détermination consistant à déterminer si le second objet peut être formé dans le troisième espace tridimensionnel ;
 une étape d'instruction consistant à émettre, à destination de l'unité de formation (264), une instruction de commande de formation ayant pour objet de former le second objet dans le troisième espace tridimensionnel sur la base des données de formation reçues par le moyen de réception (401) conformément à la détermination effectuée par le moyen de détermination (402), où, parallèlement à la formation du premier objet par l'unité de formation (264), au moins une partie du second objet est formée par l'unité de formation (264) dans le troisième espace tridimensionnel conformément à l'instruction de commande de formation émise ; et
 une étape de notification consistant à émettre une notification d'achèvement dans un cas dans lequel le processus de formation du premier objet et du second objet par l'unité de formation (264) est achevé ;

caractérisé en ce que,
 l'étape de détermination détermine si un pas entre couches de formation compris dans un paramétrage de formation du premier objet est, ou non, le même qu'un pas entre couches de formation compris dans un paramétrage de formation du second objet de façon à déterminer si le second objet peut, ou non, être formé additionnellement,
 l'étape de notification émet, dans un cas dans

- lequel le pas entre couches de formation compris dans le paramétrage de formation du premier objet n'est pas le même que le pas entre couches de formation compris dans le paramétrage de formation du second objet, une notification indiquant que le second objet ne peut pas être formé, sans émettre l'instruction de commande de formation ayant pour objet de former le second objet dans le troisième espace tridimensionnel sur la base des données de formation reçues par le moyen de réception (401) ; et l'étape d'instruction émet, à destination de l'unité de formation (264), l'instruction de commande de formation ayant pour objet de former le second objet dans le troisième espace tridimensionnel sur la base des données de formation reçues par le moyen de réception (401) dans un cas dans lequel l'étape de détermination détermine que le second objet peut être formé dans le troisième espace tridimensionnel et dans lequel le pas entre couches de formation compris dans le paramétrage de formation du premier objet est le même que le pas entre couches de formation compris dans le paramétrage de formation du second objet.
- 5
- 10
- 15
- 20
- 25
- 30
- 35
- 40
- 45
- 50
- 55
9. Procédé de commande selon la revendication 8, dans lequel, dans un cas dans lequel il est déterminé que le second objet ne peut pas être formé dans le troisième espace tridimensionnel, l'instruction de commande de formation basée sur les données de formation n'est pas émise et une notification indiquant que le second objet ne peut pas être formé est émise.
10. Procédé de commande selon la revendication 8 ou 9, dans lequel, à l'étape de détermination, il est déterminé si un type d'un matériau compris dans le paramétrage de formation du premier objet est, ou non, le même qu'un type d'un matériau compris dans le paramétrage de formation du second objet de façon à déterminer si le second objet peut, ou non, être formé additionnellement, l'étape de notification émet, dans un cas dans lequel le type du matériau compris dans le paramétrage de formation du premier objet n'est pas le même que le type du matériau compris dans le paramétrage de formation du second objet, une notification indiquant que le second objet ne peut pas être formé, sans émettre l'instruction de commande de formation ayant pour objet de former le second objet dans le troisième espace tridimensionnel sur la base des données de formation reçues par le moyen de réception (401) .
11. Procédé de commande selon l'une quelconque des revendications 8 à 10, comprenant en outre une étape de paramétrage consistant à paramétrer s'il est
- autorisé de former additionnellement un autre objet pendant la formation du premier objet, lors de l'émission d'une instruction ayant pour objet de former le premier objet.
12. Procédé de commande selon l'une quelconque des revendications 8 à 11, dans lequel, à l'étape de détermination, dans un cas dans lequel le processus de formation du premier objet et du second objet est achevé en un temps basé sur une période de temps spécifiée lors de l'émission d'une instruction ayant pour objet de former le premier objet selon lequel la formation doit être achevée, il est déterminé en outre que le second objet peut être formé additionnellement, et dans lequel, dans un cas dans lequel il est déterminé que le second objet ne peut pas être formé additionnellement, l'instruction de commande de formation basée sur les données de formation n'est pas émise et la notification indiquant que le second objet ne peut pas être formé est émise.
13. Programme informatique comprenant des instructions qui, lorsqu'elles sont exécutées par un appareil de commande de formation, amènent l'appareil de commande de formation à mettre en œuvre le procédé de commande selon l'une quelconque des revendications 8 à 12.

FIG.1

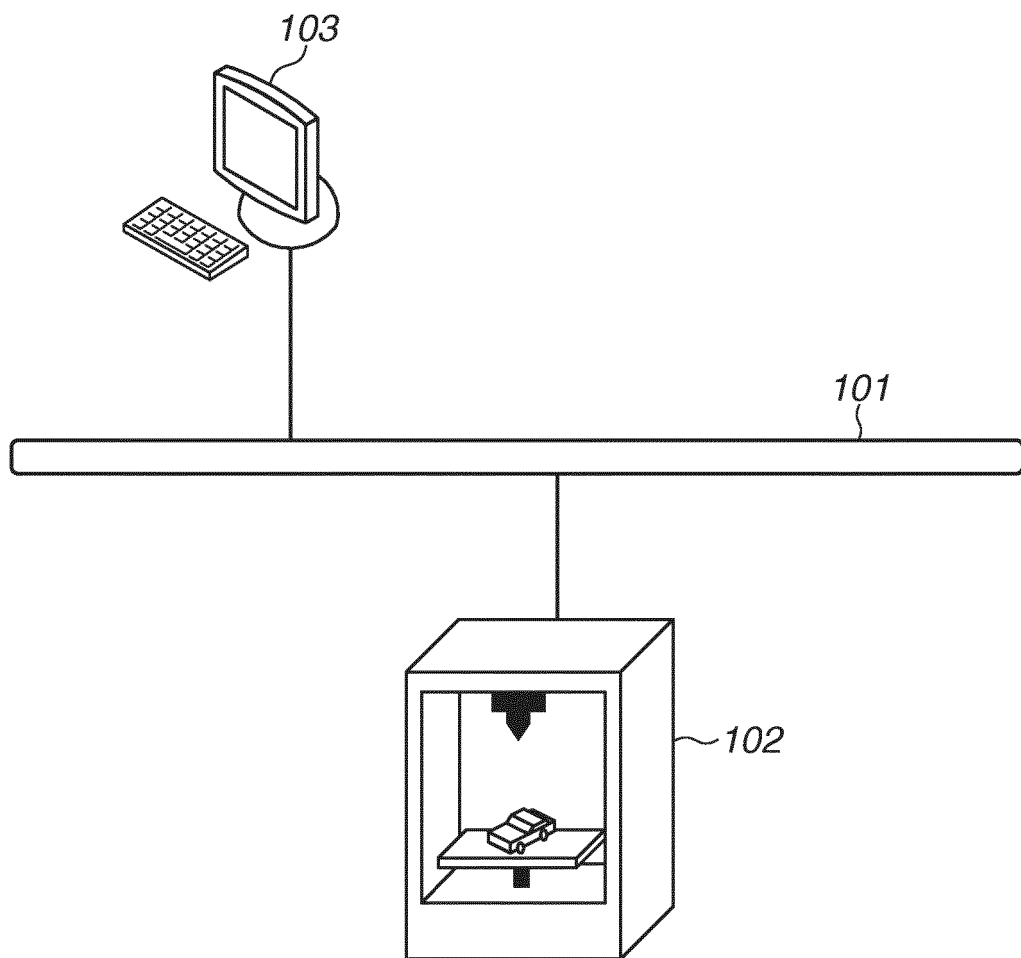


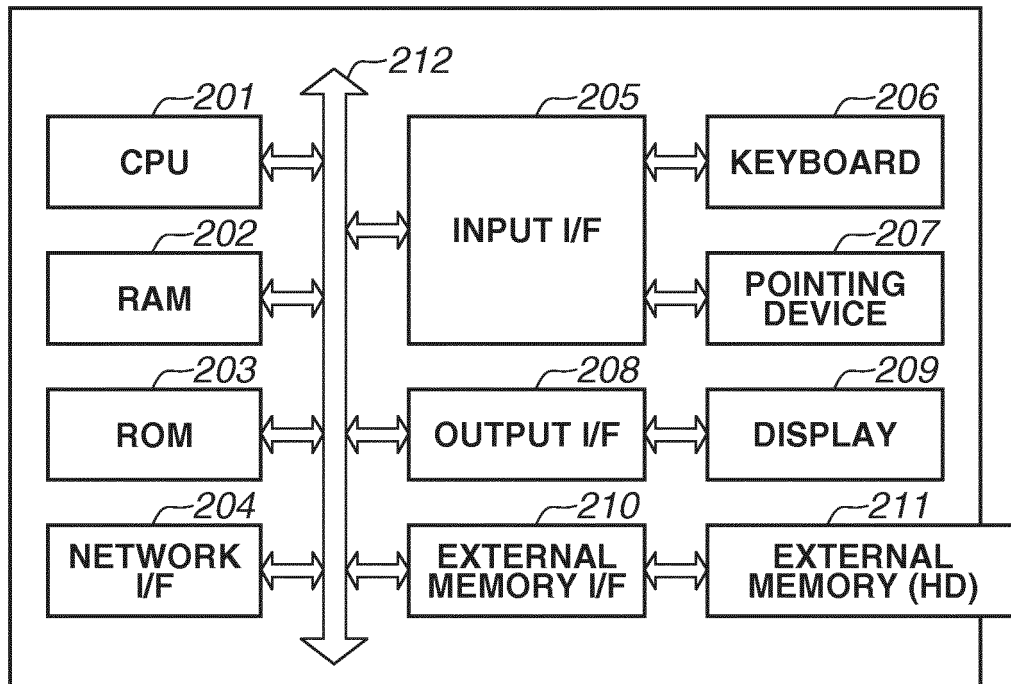
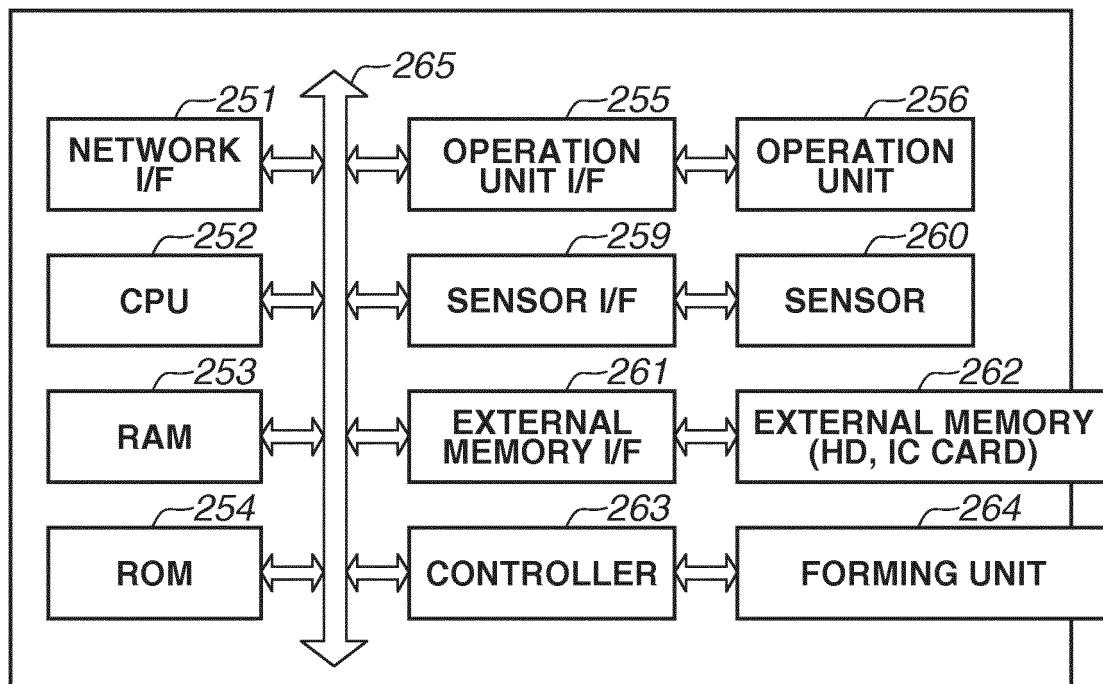
FIG.2A**FIG.2B**

FIG.3A-1
MATERIAL SHEET
LAMINATION METHOD

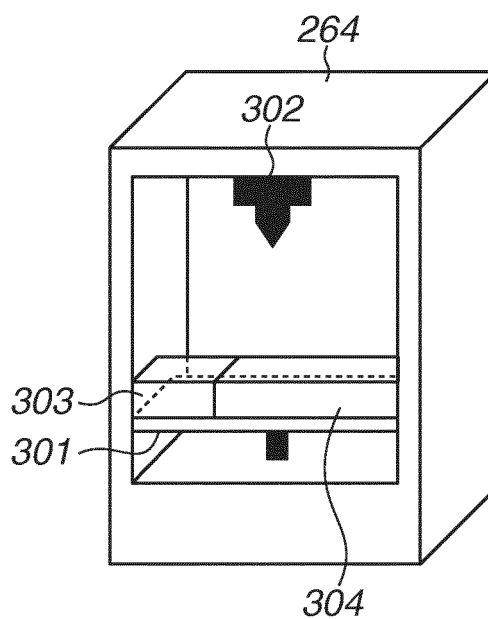


FIG.3A-2
MATERIAL SHEET

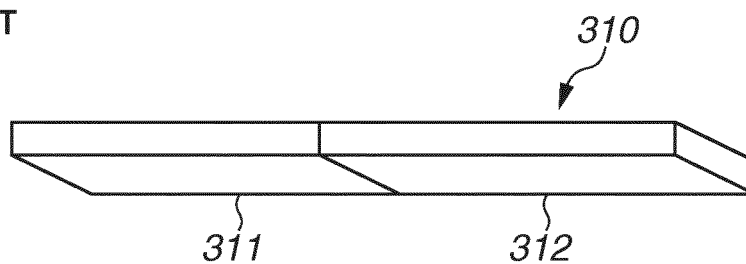


FIG.3B
STEREOLITHOGRAPHY
METHOD

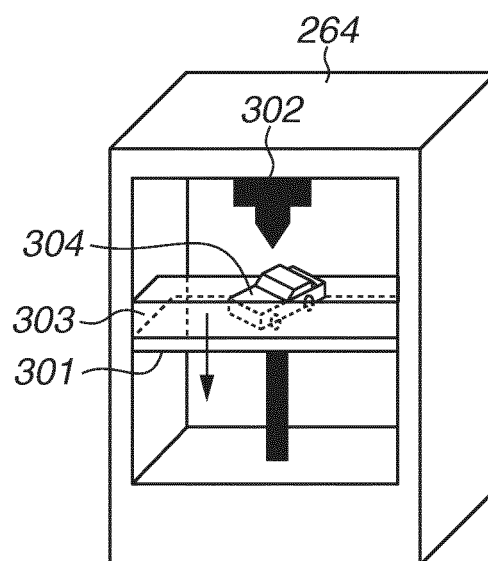


FIG.4

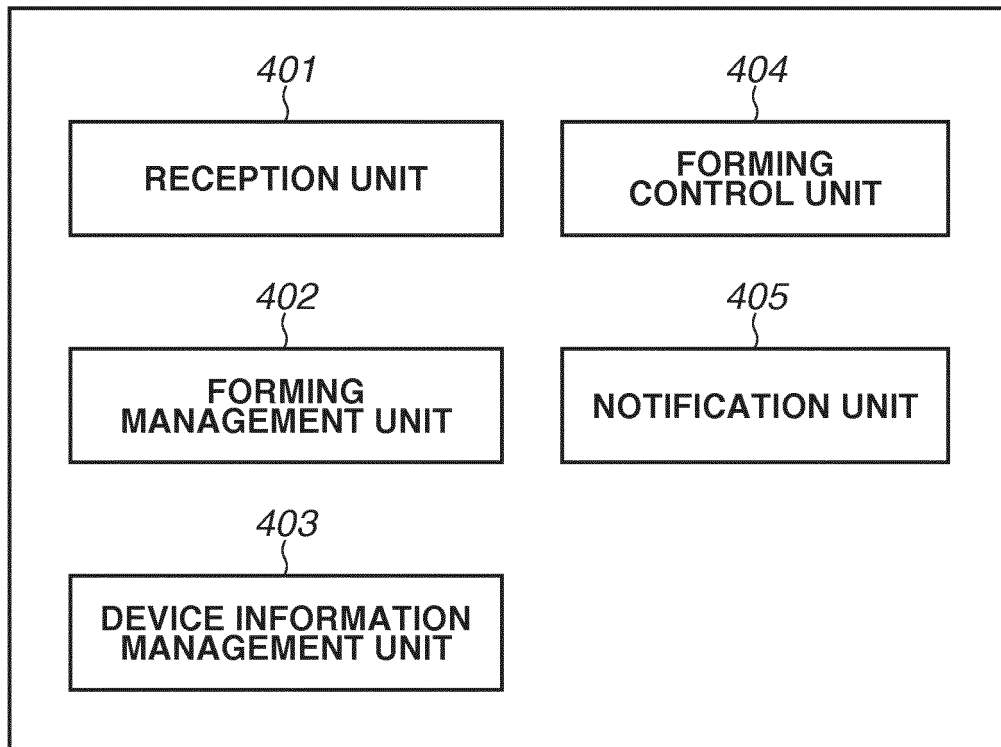


FIG.5

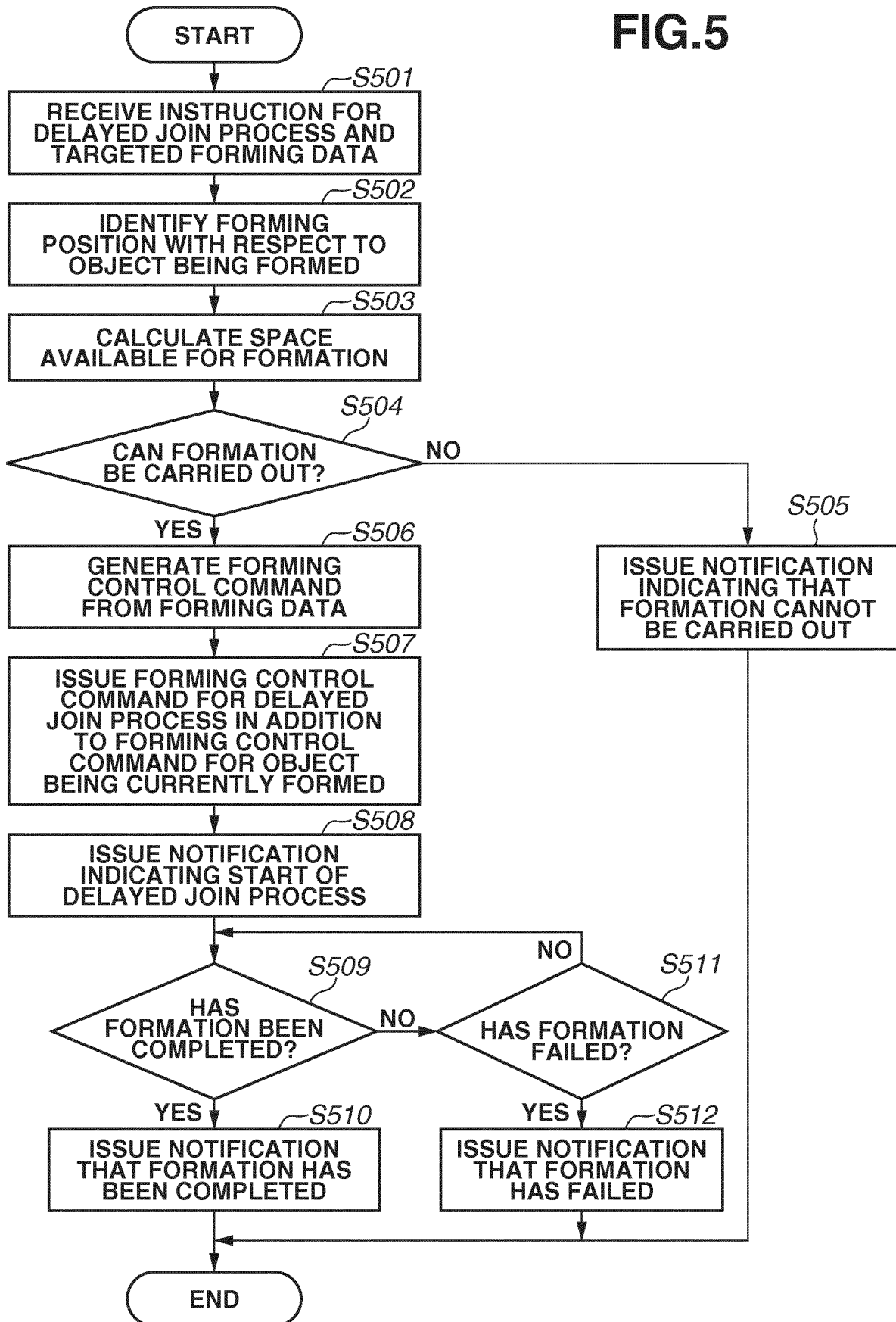


FIG.6A
PATTERN 1 FOR DELAYED JOIN PROCESS

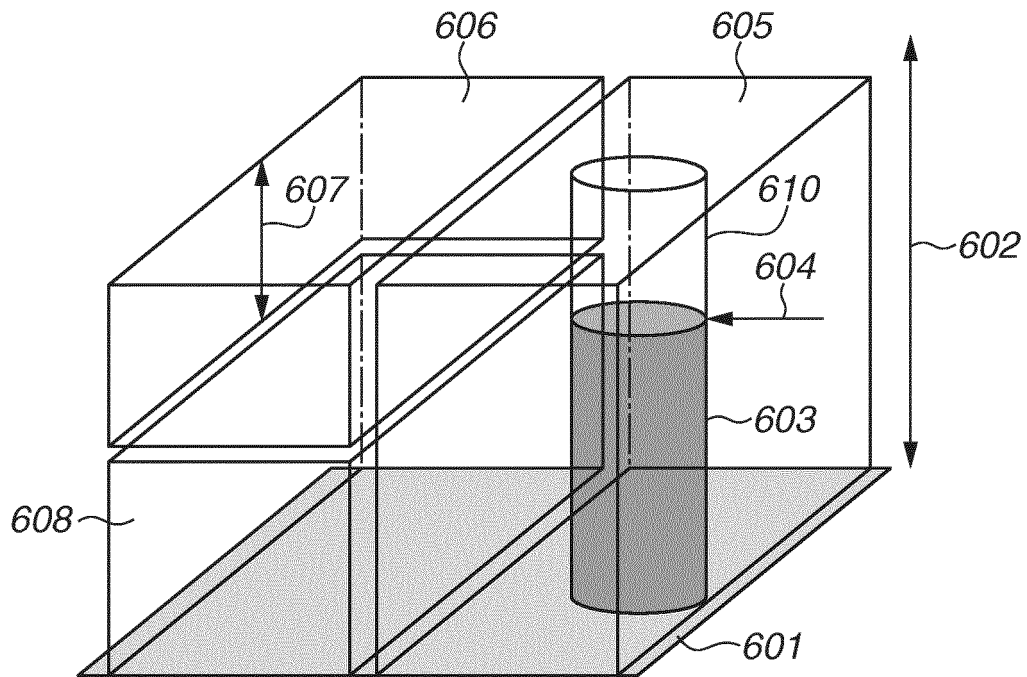


FIG.6B
PATTERN 2 FOR DELAYED JOIN PROCESS

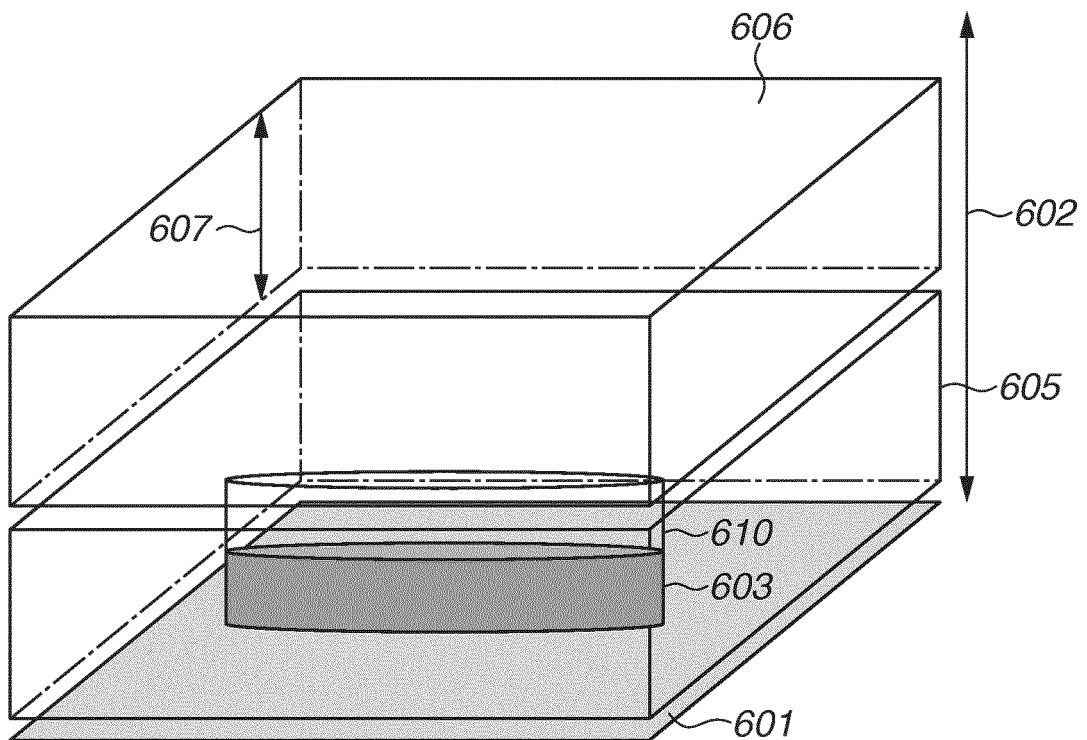


FIG.7A

701

SETTINGS OF DELAYED JOIN PROCESS

DEVICE 1 ▼ 702

FORMING SETTINGS ~ 703

QUALITY LOW ▲▼

·

·

·

·

704

ADVANCED SETTINGS

ENTER CANCEL

FIG.7B

THE DELAYED JOIN PROCESS HAS STARTED AT DEVICE 1. 710

OK

FIG.7C

THE INSTRUCTION FOR THE DELAYED JOIN PROCESS DIRECTED TO
DEVICE 1 HAS BEEN CANCELED. 711

- THE OBJECT TARGETED FOR THE DELAYED JOIN PROCESS CANNOT
BE FORMED IN THE SPACE AVAILABLE FOR THE FORMATION.

OK

FIG.8

801

SELECT 3D PRINTER

DEVICE 1 ▼ 802

FORMING SETTINGS

QUALITY LOW ▲▼

.

.

.

.

ADVANCED
SETTINGS

803

SETTINGS REGARDING DELAYED JOIN PROCESS

DELAYED JOIN PROCESS OK 804 ▲▼

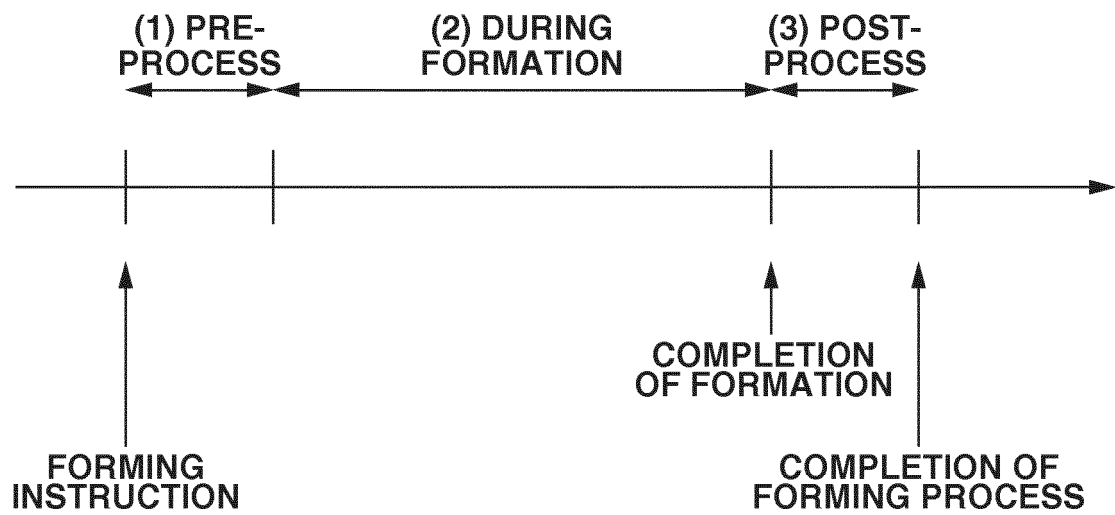
805 ☒ TIME PERIOD UNTIL
COMPLETION OF FORMATION 2 HOURS 806 ▲▼

ENTER

CANCEL

FIG.9

FORMING PROCESS



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- US 2016046074 A [0006]